LIMITED CIRCULATION

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A CLIMATOLOGY FOR ACNV PIG HOUSING AT YATTENDON, BERKS

SUMMARY

A climatological investigation of the site of an ACNV pig unit at Yattendon, Berks was conducted. Daily maximum and minimum temperatures and 2 m run of wind were recorded. Maximum temperatures were compared with those of the nearest climate station at Wallingford. The mean and standard deviation of the differnces between the two were found to be less than 1°C over a twelve month period. The daily run of wind at the two sites was compared and the cumulative frequency distributions of mean daily wind speeds were found to be very similar. The frequency of hourly temperatures $\geq$ 24°C, estimated on a monthly basis using the method of Shellard and Sarson revealed a close similarity between the two sites.

An analysis of hourly records of temperature and wind speed which was carried out for Benson (near Wallingford) for 1975-82 showed the annual frequency of hours when temperatures were $\geq$ 24°C to be slightly higher than the estimates made for Wallingford and Yattendon. The duration of temperatures $\geq$ 24°C at Benson rarely exceeded 12 hours, with the proportion of hours accompanied by a 10 m wind speed of $\leq$ 2 kts increasing from 8.7% for spells of 1-3 hours to 20.7% for spells of 10-12 hours. The incidence of spells of 3 hours or more with temperatures $\geq$ 24°C and 10 m wind speed $\leq$ 2 kts totalled 9 and occurred in only 3 of the 8 years considered. The maximum spell recorded was 7 hours. Thus in most summers conditions would be suitable for ACNV pig housing at this site and only rarely are conditions likely to be sufficiently adverse to cause difficulties.

INTRODUCTION

Climate data were required for the site of a pig fattening unit at Yattendon, near Newbury, in connection with a study of ACNV performance. The site is located at an altitude of about 120 m AMSL and is sheltered by woodland on the southern and eastern sides. Daily maximum and minimum temperatures and run of wind at 2 m were recorded at the site over a period of about a year. These data were compared with data from neighbouring meteorological stations. Comparisons were made with daily maximum and minimum temperatures and run of wind at Wallingford (about 15 km NE of Yattendon), which was the nearest station making daily meteorological observations. The nearest station for which hourly observations were available was Benson, and an analysis was made of hourly temperature and wind speed data for the period 1975-82.

METHOD AND RESULTS

Temperatures

Monthly mean maxima and minima were calculated for Yattendon and Wallingford together with the mean and standard deviation of the daily differences between the two stations. The differences between the monthly mean maximum temperatures at the two sites were generally small, the average maximum at Wallingford over the 12 month period from August 1983 to July 1984 being about 0.3°C higher than at Yattendon. Monthly mean minimum temperatures at the two sites were very similar, the average over the year for Wallingford being 0.15°C higher than that for Yattendon. The height difference between the sites is about 85 m, thus one would expect mean temperatures at Wallingford to be about 0.7°C higher than at Yattendon. However, the observed difference was less than this, due perhaps to the difference in exposure between the two sites.

Shellard and Sarson (1962) suggested an empirical method of estimating the proportion of time with temperatures above a given threshold, based on monthly mean maximum, mean minimum and mean temperatures. Table 1 shows the estimated number of hours with temperatures $\geq$ 24°C at Wallingford and Yattendon calculated by this method. Averages for Yattendon were derived using Wallingford long term averages corrected by the mean monthly temperature differences between the two sites over the period August 1983 to July 1984.

TABLE 1

ESTIMATED NO. OF HOURS PER MONTH WITH TEMPERATURES $\geq$ 24°C AT WALLINGFORD AND YATTENDON (AFTER SHELLARD AND SARSON)

	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	TOTAL
WALLINGFORD	<1	9	22	37	26	7	<1	102
YATTENDON	<1	7	22	33	22	6	<1	91

Monthly means of daily differences in maximum temperature between Yattendon and Wallingford were calculated together with their standard deviations. These are shown in Table 2.

TABLE 2

MONTHLY MEANS AND STANDARD DEVIATIONS OF DAILY DIFFERENCES IN MAXIMUM TEMPERATURE BETWEEN WALLINGFORD AND YATTENDON

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	APR-SEPT	MEAN
MEAN DAILY DIFFERENCE	0.9	0.8	0.9	0.5	0.7	0.4	0.6	0.8	0.8	0.9	0.9	0.7	0.6	0.7
STANDARD DEVIATION	1.0	1.1	1.3	0.5	0.9	0.6	0.6	1.1	1.0	1.1	1.1	0.8	0.8	0.9

The mean of the daily maximum temperature differences is less than 1°C for all months and averages 0.7°C for the year as a whole. The standard deviation of these differences is also less than 1°C for the year. Both the mean and standard deviation for April to September are less than the respective values for the whole year, suggesting that the variation in maximum temperatures between the two sites is less in summer than in winter.

The size of these differences is small and maximum temperatures at Wallingford may be taken as being reasonably representative of those at Yattendon.

Wind Speed

Daily run of wind measurements made at Yattendon over the 12 month period were compared with observations made at Wallingford. The anemometer at Wallingford is at 10 m and thus measurements were corrected to a 2 m equivalent value by a factor of 0.78 (for neutral stability). A graph was plotted of the cumulative frequency of occasions of different mean daily wind speeds for both Wallingford and Yattendon. The resulting distribution of wind speeds was similar at both sites. (Figs 1 and 2).

Hourly Data

The proximity of Benson to Wallingford (about 1 km) and the similarity in height AMSL enabled Benson to be used as a representative site for an analysis of hourly data. Table 3 shows an analysis by length of spell of hours when the temperature $\geq 24^{o}C$, and also the percentage of those hours which were accompanied by a 10 m wind speed of $\leq$ 2 kts. Spells of 3 hours or less can probably be ignored since there is a time lag of 2 to 4 hours before changing ambient temperatures are reflected inside insulated pig buildings. Table 3 shows that during the longer spells of high temperature ($\geq$ 7 hours) the percentage of hours with a wind speed $\leq$ 2 kts is greater than during the shorter spells. Thus adverse conditions are more likely to occur during spells of 7 hours or more with temperatures $\geq 24^{o}C$ than during shorter spells. Fig. 3 shows the percentage of hours with the temperature $\geq 24^{o}C$ and 10 m wind speed $\leq$ 2 kts forming spells of different duration at Benson. It can be seen that only about 6% of all hours consist of spells of 7 or more consecutive hours of adverse conditions and only about 33% of all hours comprise spells of 3 or more consecutive hours. Thus only about 33% of all hours when temperatures $\geq 24^{o}C$ and wind speed $\leq$ 2 kts are likely to be adverse for ACNV. Table 4 shows that on average there were 134 hours per year when temperatures were $\geq 24^{o}C$, 13 of which also had wind speed of $\leq$ 2 kts. It can be seen that approximately 60% of occasions of both high temperatures and high temperatures and low wind speeds occurred during the two years of 1975 and 1976. In 1975 the total was almost twice the average over the 8 year period, and in 1976 about three times the average. In only 3 of the 8 years considered, 1975, 76 and 77, did adverse conditions persist for 3 hours or more, and the maximum duration was 7 hours. Unfortunately, hourly data for Benson were not available for the hot summers of 1983 and 1984.

TABLE 3

% OF TIME WITH TEMPERATURES $\geq 24^{o}C$ WHEN 10 m WIND SPEED $\leq$ 2 KTS FOR DIFFERENT DURATIONS AT BENSON (1975-82)

DURATION OF SPELL (CONSECUTIVE HOURS)	NO. OF SPELLS WHEN TEMP $\geq 24^{o}C$	NO. OF HOURS WHEN TEMP $\geq 24^{o}C$	% OF HOURS WHEN TEMP $\geq 24^{o}C$ WITH 10 M WINDSPEED $\leq$ 2 KTS
1-3	63	108	8.7
4-6	60	308	4.7
7-9	40	311	16.3
10-12	23	247	20.7
$\geq$ 13	7	98	12.1
ALL	193	1072	9.6

TABLE 4

NO. OF HOURS PER YEAR WITH a) TEMPERATURE $\geq 24^{o}C$ AND b) TEMPERATURE $\geq 24^{o}C$ AND WIND SPEED ≤ 2 KTS, AT BENSON (1975-82)

	(a)	(b)		
YEAR	TOTAL HOURS WITH TEMP $\geq 24^{o}C$	HOURS WITH TEMP $\geq 24^{o}C$ AND WIND SPEED ≤ 2 KTS		
		TOTAL	NO OF SPELLS ≥ 3 HOURS	MAX SPELL LENGTH (HOURS)
1975	246	21	2	3
1976	393	42	5	5
1977	64	8	2	7
1978	37	2	0	1
1979	78	9	0	2
1980	54	0	0	0
1981	86	18	0	2
1982	114	3	0	2
TOTAL	1072	103	9	-
AVERAGE	134	13	1.1	2.8

CONCLUSIONS

The climate of Yattendon is very similar to the nearby meteorological stations at Wallingford and Benson, and it was possible to use these stations to derive a climatology for ACNV pig housing at Yattendon. The simultaneous occurrence of conditions of high temperatures and low wind speeds likely to be adverse to ACNV is small in most years, but in the hotter summers some problems may occur. On average one would expect about one spell per year of adverse conditions lasting 3 hours or more, but in reality these are likely to occur only in the hotter summers, about one year in three. During the cooler and near normal summers the occurrence of adverse conditions is likely to be rare. Although this climatology has been derived for a specific site, it is considered to be fairly representative of many inland sites in the SE Region.

Humidities were not monitored during this investigation, although during periods of high ambient relative humidity the pigs were observed to become increasingly soiled and showed signs of discomfort. It is suggested that any further investigations into the effectiveness of ACNV pig housing during conditions of high temperatures should also take account of internal and external humidities.

Key Words Animal Housing, Ventilation, Pig comfort, Cold/heat stress.

Any comments or suggestions relating to this paper should be sent to the author.

Reference

Shellard, H C and Sarson, P B. Estimation of frequency distribution of hourly temperatures at United Kingdom stations from monthly averages of daily maxima and minima.

Met.Mag.91 (1962), 19-26.

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Fig.1 Cumulative Frequency of Different Mean Daily Windspeeds at Wallingford

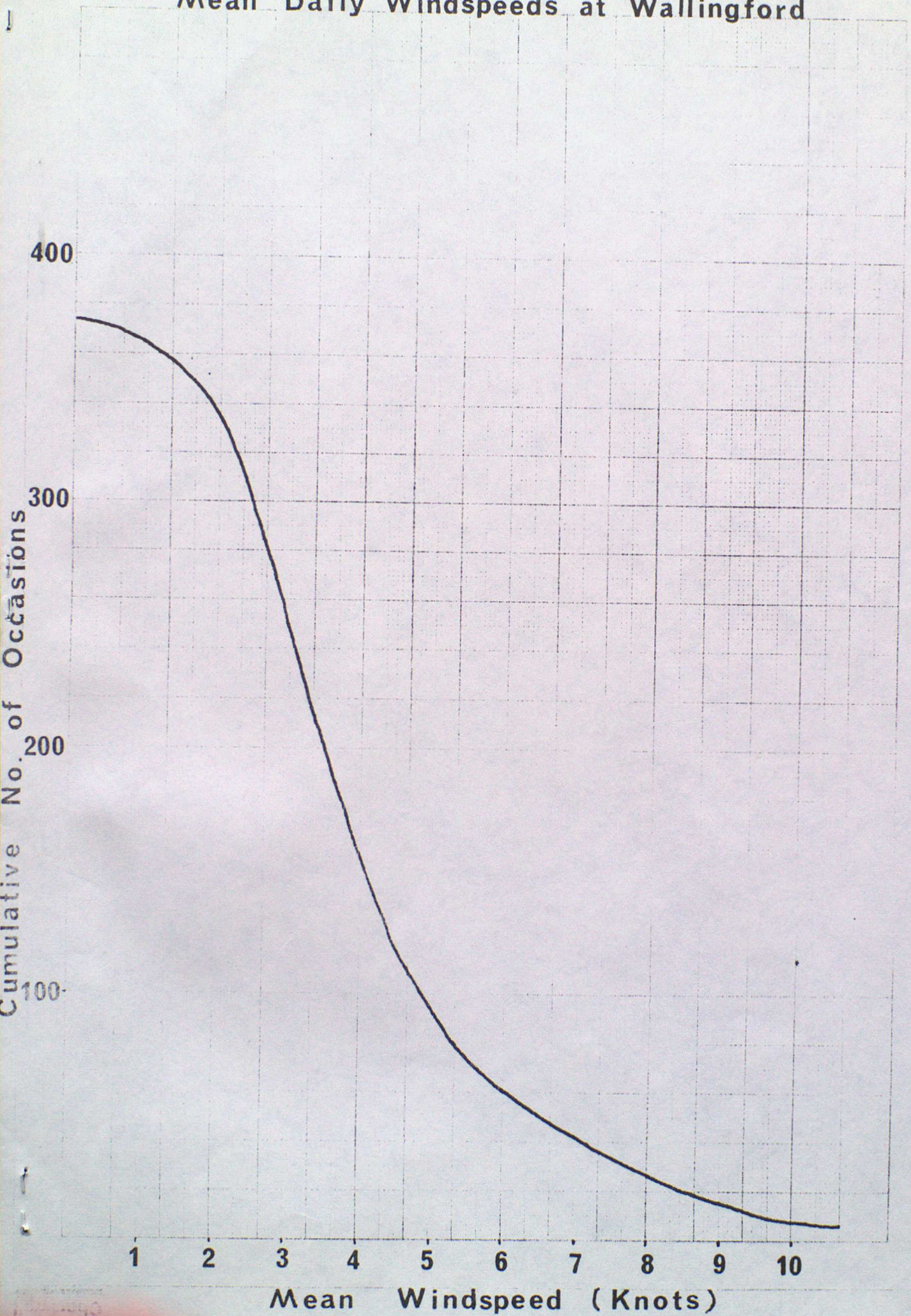

Fig.2. Cumulative Frequency of Different Mean Daily Windspeeds at Yattendon

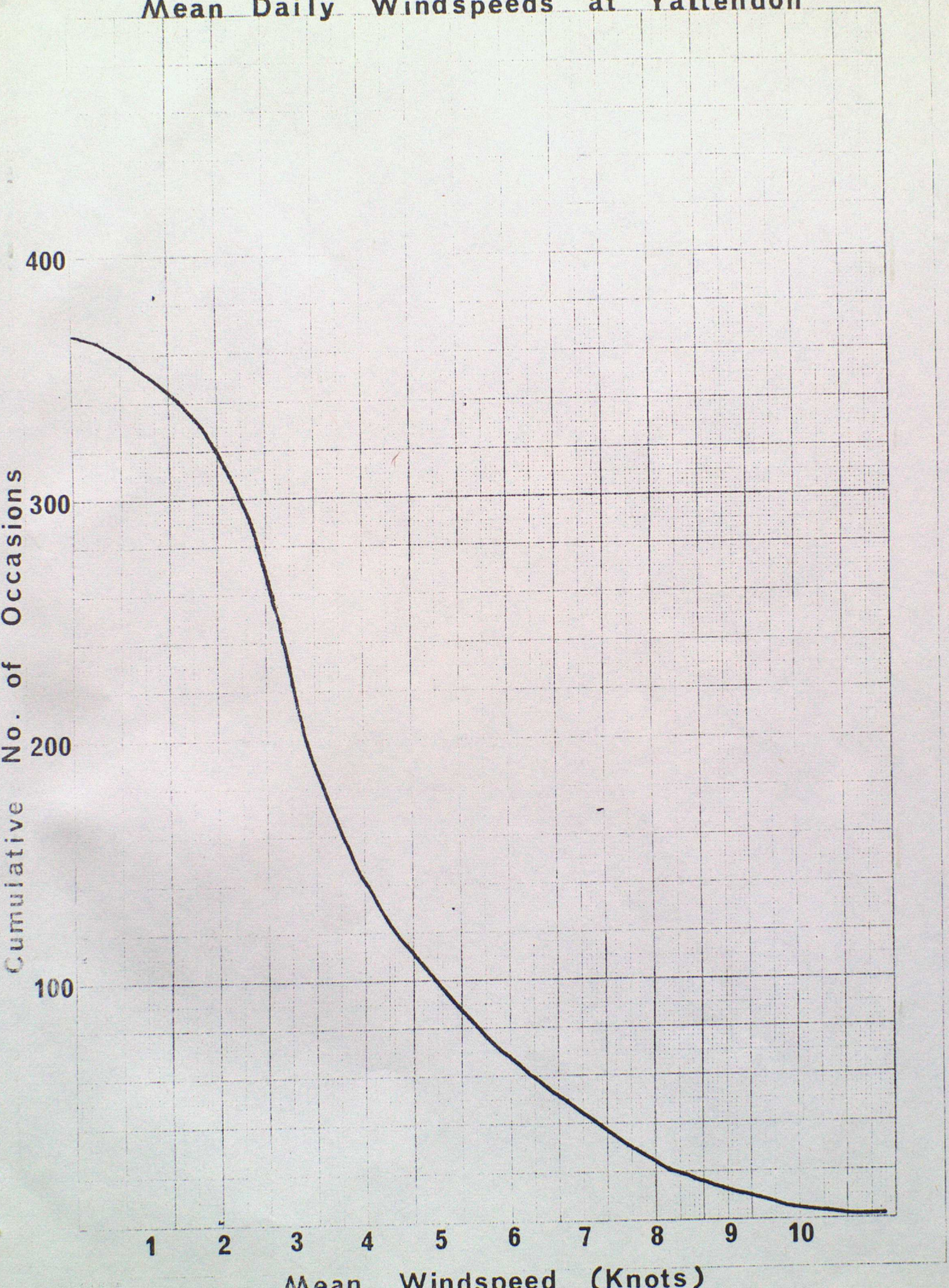

Fig 3 Percentage of Hours With Temperature $\geq 24^{o}C$ & Windspeed $\leq$ 2 Kt. Forming Spells of Different Duration at Benson